OTTER

ASTERN NORTH PACIFIC WATERS

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DISTRIBUTION OF THE SEA OTTER

SEA

OTTER

IN EASTERN NORTH PACIFIC WATERS

Compiled by Alice Seed
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PREFACE

In response to mounting interest in the wildlife native to the Pacific Northwest and Alaska, and to a need for non-technical accounts about the various species, Pacific Search presents this booklet. Second of a series, it is intended to acquaint the reader with the sea otter — a unique member of our wildlife community.

A bibliography is included for those interested in further reading, but it is obviously only a fraction of the literature about this fascinating marine mammal.

The editor wishes to thank those who have so generously given of their time, contributed articles, one of which has appeared in *Pacific Search,* photographs, and art work that have made this booklet possible.

Alice Seed

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INTRODUCTION

Paul W. Wild

Among all marine mammals, the sea otter, *Enhydra lutris*, is probably the most fascinating and unique of these warm-blooded creatures inhabiting the world's seas. The sea otter's natural history, the role it played as a valuable furbearer in the exploration of the North Pacific Ocean and the settlement of the west coast of North America, as well as its remarkable recovery from the brink of extinction in modern times, provide interesting and exciting drama. In recent years, research conducted on recovering sea otter populations, by scientists concerned with the conservation of these mammals, has expanded our knowledge of sea otters and has helped to insure the continuation of healthy, flourishing populations.

The sea otter, the only marine mammal of the order *Carnivora,* is a member of the family *Mustelidae,* which includes among others, the river otter, weasel, mink, badger, and skunk, many of which are also valuable furbearers. While the sea otter is the largest mustelid, it is the smallest marine mammal. Although the fossil record is incomplete, available evidence indicates that the sea otter evolved well over a million years ago from a land dwelling ancestor that went to sea. It is speculated that *Enhydra* was derived from Asiatic stock and moved northward along the western shore of the North Pacific Ocean with the accentuation of favorable climatic conditions. Eventually, the sea otter occupied a range that extended in a more or less continuous band 6000 miles long from northern Japan up along the Kamchatka peninsula of Siberia, across the Aleutian Island chain, and down the west coast of North America to mid-Baja California and numbered an estimated 150,000 animals prior to over-exploitation by fur hunters. Today an estimated 50,000 sea otters occupy perhaps a fourth of the former range with the largest reestablish-

ed populations in the north, from Alaska across the Aleutian and Commander Islands and the Kurile Islands south of Kamchatka. Far to the south off central California, a reestablished population now numbers well over a thousand animals along 140 miles of rugged coastline.

The sea otter is well adapted to live in the shallow waters along the mainland and island coasts where it occurs. While sea otters do not have an insulating layer of blubber like most marine mammals, their body heat is maintained by dense, luxuriant fur, which traps a layer of insulating air next to their skin.

The webbed hind feet are modified into flipper-like appendages with the outer fifth digit the longest, a unique adaptation which increases efficiency of propulsion by the foot when the otter swims on its back, a common mode of travel.

The flattened tail may be used as a sculling oar in conjunction with the hind feet when swimming, or by itself for moving short distances or making small maneuvers.

The forepaws, not used for propulsion, are utilized for food gathering and feeding, tool use when foraging and feeding, and for frequent preening and fluffing of the fur.

The sea otter is a voracious feeder. Its food consists primarily of mollusks, crustaceans, echinoderms, and fish, depending on availability, preference, and location. Fish are an important item in the diet in Alaska, but not in California. Tool using behavior is exhibited more commonly in California, where sea otters crack open mussels and clams on a rock balanced on the chest or pound with a stone held between forepaws to dislodge an abalone or smash open a large barnacle on the sea floor. In California, the sea otter with its voracious appetite and propensity for abalone, combined with an expanding population, has so thoroughly foraged within productive red abalone beds that commercial divers have abandoned all the beds within the sea otter's range.

All life activities, including mating, bearing young, foraging, feeding, resting, sleeping, and playing, occur in the water. In California, hauling out behavior rarely occurs, but in the north, hauling out on shore for resting or sleeping is common.

Sea otters are generally very gregarious and large groups of animals, known as "rafts," may contain well over a hundred individuals floating on their backs in close association to each other. They segregate by sex, a phenomenon more defined in adults, and large groups may be nearly all males or primarily

females. Several mothers with pups are often observed in a raft in female areas.

The maternal care and solicitude for the young have endeared sea otters to humans wherever this behavior is observed. A family group is not formed, and the indiscriminate males eventually return to male areas after participating in mating activity.

Primitive man was cognizant of the sea otter for centuries. Drawings and carvings of sea otters occur among Indian artistic renderings. Sea otter bones are found in Indian middens all along the west coast of North America and on the channel islands of southern California. The Aleutian Indians and others living in the cold, inhospitable lands to the north made good use of the dense, luxuriant sea otter fur for warm clothing and bedding. Probably because of this greater need, the "Aleut" learned to hunt the sea otter more skillfully with his baidarka (seal skin kayak) and spear, than did the Indians to the south.

The Japanese reportedly took sea otters in their islands for hundreds of years. In 1733, Padre Sigismundo Taraval observed sea otters at Cedros Island, Baja California, and later in that century, Spaniards traded for sea otter furs with the Indians of upper and lower California, unaware of the high value placed on these magnificent furs in the orient.

An extensive slaughter of sea otters began with the return of members of the ill-fated Bering expedition in 1742. Their cache of luxuriant skins and tales of vast numbers of sea otters around the islands to the north, encouraged a harvest that went on unhindered for 170 years. So incessant was the pursuit that by the time protection was obtained in 1911 by international agreement, the sea otter was extinct commercially and nearly extinct as a species. Subsequently, federal and state laws provided further protection, and slowly sea otters began to make a comeback. Occasional sightings of sea otters during the early decades of this century indicated that small population nuclei remained after the hunting had ceased and were beginning to expand in Alaska, along the islands in the Aleutian chain, at the tip of Kamchatka, in the Kuriles, and off central California. By the 1940's, it was apparent that the sea otter definitely had staged a comeback.

Interest in this unique sea mammal by scientist and layman alike has fostered considerable scientific investigation, which has expanded our knowledge of sea otters. Successful long-term sustenance of sea otters in captivity and recent successful trans-

plants to the coasts of southern Alaska, British Columbia, Washington, and Oregon have relied heavily on this information.

In 1968, the California Department of Fish and Game initiated a sea otter research project to study the sea otter population off California and its relationship to the near-shore area, as well as to arrive at solutions to problems related to resource uses by man and the sea otter. All scientific studies dedicated to the conservation of this unique sea mammal will help to assure sea otters a promising future in the North Pacific Ocean.

An adult female sea otter. Photo by Karl W. Kenyon

A subadult otter lying on its back on an Amchitka beach in typical defensive posture. The claws on the front paws are shown in retracted position. Photo by Karl W. Kenyon

THE SEA OTTER HUNTERS 1741-1911

Lucille Palmer

Storm-tossed waves on the shores of Kamchatka peninsula drew keen-eyed watchers in the early eighteenth century. Siberian fur hunters knew that the fury of a Pacific storm sometimes brought wealth to their beaches.

Sea otters, smallest of the marine mammals and carriers of the most beautiful fur known to man, were often swept to Kamchatka by winds and waves too great for them to battle. Rubles filled the pockets of the hunter lucky enough to kill these rare creatures, for to keep warm in the frigid ocean waters the animals had developed a fur so dense and fine that the pelts were reserved for royal raiment.

But the home of the otters remained unknown to the hunters. They knew the animals must live somewhere in the misty distance, but excursions in small boats failed to find them. Before the year 1741 was over, however, a drama of brave men against the sea unfolded that ultimately revealed the habitat of sea otters to the eager hunters. A massive slaughter ensued that almost exterminated the species *Enhydra lutris.*

The drama began when Vitus Bering, a Danish explorer in the service of Russia, took command of an expedition, one of whose goals was to find Gamaland, a continent believed to lie in the North Pacific. Searching the wind-swept sea for something that was not there discouraged the crew. Scurvy, the ancient scourge of seamen, took its toll, and a weak and hopeless Bering turned homeward. Just off the Komandorski Islands—the western geographical tip of the Aleutians—foul weather became his brutal enemy. In a freak surge, a wave of savage power hurled

his ship, the St. Peter, far up on the beach and dropped her like a broken plaything. Bering and many of his crew soon succumbed. They were laid in lonely graves on the island that now is called "Bering."

The survivors found that they had merely exchanged death by scurvy and shipwreck for death by starvation and cold. Except for a few roots and herbs, nothing edible grew on the treeless island, inhabited only by packs of hungry blue foxes. Food from the sea would be hard to come by without ship or gear. It was December, and the numbing arctic cold penetrated the worn clothing of the castaways.

The least ill of the men formed a patrol to scout for food. On a beach near where their wrecked ship lay on her side, they were surprised to come upon sea otters sleeping. The hungry men quickly clubbed them to death and slung the carcasses over their shoulders. One can imagine their triumphant return to their comrades with meat for the pot.

After satisfying their hunger with the tough, tasteless flesh, the men set about turning the raw pelts into warm clothing. Capes, caps, and sleeping robes were made of the world's finest furs. And the patrol had sighted dozens more of the animals gamboling in offshore kelp beds. Keeping watch on the beach, they found that the otters hauled out to groom their fur and to sleep. The little mammals fell easy prey to the seamen who could at last keep their bellies full and their bodies warm.

Once hunger and cold were conquered, strength and hope began to return to the castaways. They held a council under Lieutenant Waxel, who had been Bering's First Officer. Their only prospect of ever escaping their imprisonment on Bering Island, they decided, was to dismantle their crippled ship and build a smaller vessel from her undamaged timbers and planking. But winter snows blanketed the island, hampering these difficult operations, and one day the hunters found to their dismay that the otter herd on their beach was gone. The men had slaughtered every animal that came ashore until there were none left in the kelp beds.

Reasoning that there might be other herds on the island, the food detail stumbled over frosty, rocky terrain for a long distance until they came to another beach where innocent otters slept soundly, as they had done for generations. This time the men butchered more than required to meet their needs, for, with a hope of returning to Kamchatka, each man desired to

take a few pelts for himself. The extra meat was thrown to the ever-ravenous blue foxes.

Winter, spring, and most of summer passed in a frenzy of shipbuilding and hunting. Although Steller's sea cow was discovered to be a good source of tender, beef-like meat for the colony, the hunters still pursued the otters for pelts, and the blue foxes were well fed.

In late summer of 1742 the long ordeal on Bering Island came to an end. The 45 men crowded onto the 41-foot vessel they had built and a course was set. Three weeks later their anchor dropped in Avacha Bay, Kamchatka, their home port.

Pandemonium reigned in the port at the sight of the raw pelts the men brought. Whatever price an owner demanded was paid. Even the weather-beaten clothing off the men's backs was bid on, for no piece of the lustrous fur was too small to be used for gloves, handbags, and trimmings.

But more precious than the furs was the knowledge the mariners brought. They knew where the otters lived! This handful of haggard men could lead the hunters to an island where sea otters by the hundred were just waiting to be harvested.

The fur fever raced through Kamchatka. Flimsy ships were hastily readied. Water casks were filled, and sails were set with little thought for the hazards of a voyage to uncharted shores. Traders in Canton and Macao offered the highest prices for sea otter pelts and wherever such pelts were known to be, the bold *promyshleniki*—the fur hunters of Siberia—would venture. The dangers seemed no greater than in tracking the Russian sable in Siberian wildernesses.

For many it was a funeral voyage. The expedition was poorly equipped and unprepared for the full fury of the Pacific. It is estimated that less than half of those first, hopeful voyagers were heard from again. But when one little ship found Bering Island and groped its way home with a cargo of furs worth a half-million dollars, those who didn't come back were forgotten.

Sturdier ships were built at Kamchatka. Space below decks was reserved for fur storage only. The men lived topside in the open, with no protection from the elements except for their thick clothing and their own body heat. Once at the hunting grounds, they went over the side and disappeared in the fog in little skin skiffs. Propelled with double-ended paddles, the featherweight kayaks darted into the kelp beds, the men clubbing, spearing, harpooning as long as an otter could be found. With

such intensive pursuit the Komandorski herds were exterminated, the searching ships sailed eastward, and the plunder of the Aleutians began.

Attu and Agattu, the next islands reached, were inhabited by Aleuts who made their living almost entirely from the sea. They depended heavily on the sea otter, and became alarmed at the destruction of their herds. But the hunters were accustomed to taking what they wanted from the sea and continued to do so. A pattern of warfare developed between the two cultures. While the *promyshleniki* hunted otters, Aleuts hunted the hunters. A ship's captain, awaiting the return of his kayak-hunters, might know of their deaths only when he was attacked by Aleuts wearing the hunters' clothing. And kayaks sometimes returned to their ship to find only a burned wreck on the beach with the corpses of captain and comrades. Whole Aleut villages were destroyed to clear the way for the greedy hunters.

Ships hid in foggy, reef-strewn bays and kayaks slid over the side to hunt in the worst weather, for a screaming williwaw drowned out the human sounds that could alert both the wary otters and the wiley Aleuts. There were many accounts of hardship, barbarity and murder. The crack of club hit human as well as other skulls and was as lethal. Crunching ice floes and wave-battered beaches became battlefields where Russian brute force met with native cunning.

Still the reckless *promyshleniki* plunged eastward from island to island until the American continent was reached. Each ship returning with its wealth of furs set blood tingling anew, and the fleet grew in size. Some ships were manned by Siberian exiles, branded criminals, and political outcasts, who were not above turning on a rival ship.

The sea otters—members of the intelligent weasel family—changed their way of life. They no longer slept or groomed on beaches. They hauled out on shore only when the most violent storms churned the kelp beds and sent foaming waves breaking over their heads. Kayaks could no longer approach the wary animals at clubbing range. Marked spears were thrown instead. The hunter whose mark was on the spear nearest the nose claimed the pelt—a sly way of assuring undamaged pelts. Nets were strung near feeding places. The little air-breathing mammals were ensnared when diving for food and quickly drowned. By every method man could devise the animals were captured, and wealth poured into Russian coffers for 40 years.

The scene changed in 1778 when Captain James Cook sailed around the bottom of the world from England. His mission was to discover the fabled Northwest Passage that the Greek pilot, Juan de Fuca (born Apostolos Valerianos) claimed to have found in 1592. Sailing slowly up the coast of northwest North America, Cook was pleased to be able to buy many fine sea otter pelts from the Indians at Nootka Sound for a few fishhooks and trinkets. Like Bering's men, Cook's men used the furs for warm bedding and clothing as they sailed into the icy reaches of the high latitudes. Serving with Cook were Nathaniel Portlock, George Dixon, John Ledyard, and Midshipman George Vancouver, all of whom would later play a part in the fur trade.

Captain Cook lost his life on the voyage and his officers took the ships back to England. Going by way of China, they were hard put to avoid a mutiny when Chinese merchants fell on the crew's worn fur clothing. What the men had purchased for fishhooks, and used so roughly, sold for $10,000. The seamen demanded an immediate return to Nootka for a full cargo and instant fortunes; but the officers knew the ships were in no shape to cross the Pacific again.

Portlock and Dixon were the first to return. They bought furs from the Indians for fishhooks, iron chisels, and pieces of copper. The cargo sold for $55,000. More European vessels scurried around the Horn. The Russian monopoly was cracked. Chinese merchants welcomed these new traders who brought pelts directly from the hunting grounds. Their Russian supply from land routes had reduced to a trickle.

The Spaniards, who regarded the Pacific coasts of all the Americas as their territory, closed Nootka Sound to the English and seized incoming English ships as prizes. This almost precipitated a war between England and Spain over—in the words of Thomas Paine—"Nootka catskins." After a diplomatic settlement, the port was again opened.

In Boston, John Ledyard's report of his voyage with Cook sent Captains Gray and Kendrick to the Pacific under the American flag. (It was on such a fur-gathering voyage that Captain Gray discovered the Columbia River and named it after his ship.)

In 1792 Captain George Vancouver again sailed the route he had traveled as a midshipman. He entered Juan de Fuca's Strait and proved that it was not a Northwest Passage. His journal recorded that the finest sea otter pelts were thrown to the Englishmen by coastal Indians for any trifling article of clothing. This

news sent ships of England, France, Spain, Portugal, and many lesser powers racing to the ottering grounds.

Lewis and Clark reached the western edge of the continent in 1806 and referred to the animals whose pelts they saw as "sea-orter pole-cats." Lewis wrote in his journal,

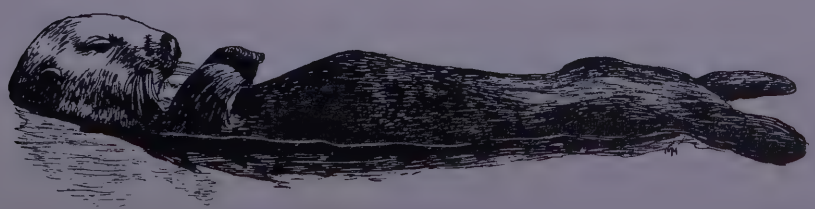
> . . .it is the richest and I think the most delicious fur in the world at least I cannot form an idea of any more so. It is deep thick silkey in the extreem and strong.

When this report reached the east coast, the Americans plunged headlong into the fur trade. A great triangle route was established. Ships left Boston laden with goods favored by Northwest Indians; left Nootka Sound laden with furs for China; left China with such cargo as porcelains, silks, nankeens, ivory, and tea for the growing American population. Half a hundred fur companies sprang up.

There was no longer any unmolested habitat for the otters. Asians, Americans, and Europeans combed every shore, reef, and kelp bed in the northern seas, from southern California around the sweeping bend of land to northern Japan. The unique, protective pelage that enabled the otter to live doomed it to death.

By the turn of the century it was estimated that the annual kill far exceeded the natural increase, and the bearer of the world's most beautiful and durable fur would disappear forever from the earth. Early conservationists had begged that only Aleuts be allowed to hunt the animals and that only males be taken, but rules were not established.

In 1911, when the species was feared by many to be extinct, the four nations whose lands border the North Pacific recognized the need to protect any remaining otters. The United States, Great Britian, Russia, and Japan signed a treaty making it illegal to kill a sea otter or to possess its pelt. And so, by mutual agreement among four great powers, the long-lasting otter slaughter came to an end.



THE SEA OTTER AND NATIVE CULTURES OF THE EASTERN NORTH PACIFIC

Harold L. Amoss

In aboriginal times, the sea otter was found among the kelp beds and along the rocky shores of the northern rim of the Pacific Ocean, primarily from Baja California north to Alaska's Aleutian Islands. All who saw this mild and beautiful sea mammal, and especially those who hunted it, remarked on its quickness and cunning, its playfulness, its humanlike interest in its young, and the characteristic posture of repose on the surface of the sea, with just its nostrils showing.

This sleeping posture has been captured by early Kwakiutl Indian artists. Sea otter appears on Kawkiutl masks, house posts, totem poles, and feast dishes, and can always be recognized from being depicted on its back with head thrust forward touching its chest, as if it were sleeping or eating on the surface of the sea. When sea otter is depicted vertically on house posts, it must be thought of as actually lying horizontally on the water, with a sea urchin on its chest.

Sea otter appeared in Kwakiutl art because sea otter was a being, along with other animals, that shared the natural and supernatural world with man. Its name, among others, was invoked during the winter ceremonials, when the audience was to be impressed with the seriousness of its relation to the supernatural world. In the Kwakiutl view, the earth was not populated

with inanimate things or soulless animals that could be exploited without penalty, but was shared by many beings who also had power. Sometimes this power was used against man, and sometimes it was given to man. Man's role was one of harmony with, rather than dominion over the creatures of land and sea.

All the native peoples along the coast, from the Aleutian Islands to about San Francisco Bay, hunted the sea otter. The Kwakiutl, living around the head of Queen Charlotte Strait, utilized the sea otter, but did not consider it as important as some other animals. Only a few otter penetrated the waters south of this area into the interior channels between Vancouver Island and the mainland, and still further south, no sea otter were found inside the Strait of Juan de Fuca.

Among those Indian groups that lived prehistorically along the coast of what is now southeast Alaska, the north coast of British Columbia, and the west coast of Vancouver Island, there was considerable similarity in hunting methods. Before leaving for the hunt, the hunters had to forgo their wives and worldly associations, isolate themselves in lonely places for days and nights praying and fasting. By this means they gained the courage and power to succeed. On the day of the hunt many dugout canoes, each commanded by a high-ranking man, were paddled into proximity of the sea otter. When the hunters in one canoe spied an animal asleep on the water, they attempted to get close enough to strike it with a harpoon that the struggling animal could not easily dislodge. When struck, the sea otter sounded, trailing the harpoon pole. But the hunters, knowing it must surface again soon for air, tried to guess where it would come up. When the quarry first sounded, the hunter who made the initial strike would signal to the other canoes the spot of probable reappearance, and they would try to surround that spot.

It has been suggested that this technique may predate a similar one used by the same people in whale hunting, but evidence for ordering these methods in time is insufficient. While the techniques appear similar, it is notable that by historical times the Nootka and Makah were best known for their whaling, and the Haida of the Queen Charlotte Islands, who did not hunt whales, were the best Indian hunters of the sea otter.

South of Cape Flattery, along the coast almost to San Francisco Bay, it has been reported that sea otter hunters primarily sought their quarry on land, hoping to kill the animals before they got back to the water, or depending on wave action to bring

back to shore the dead bodies of sea otters they had wounded.

Before the coming of the white man, the sea otter was hunted for food, and its skin was used to trim blankets and robes. Only these simple needs were satisfied, and there was no reason for wanton killing. When Captain James Cook, in 1778, explored what is now called Cook Inlet, Alaska, in search of the fabled Northwest Passage, his men engaged in a brisk trade with the natives. Cook's diary reports that the natives were prepared to sell any sea otter skins they had, apparently unaware of their value.

The Chinese, however, prized sea otter skins very highly,

A Nootka sea otter hunter - from a 1915 photo by Edward S. Curtis

and were willing to pay extravagant sums for them. They seem to have been the first to covet the fur of the sea otter, getting it from Japanese and Ainu hunters. There were not enough skins to satisfy this market.

The Russians entered the scene after 1732. There was a hungry European market for this fabulous fur, but the profits to be made in the Chinese market were almost unbelievable. The Russians were more interested in sea otter skins than anything else—gold, land, or dominion. They ruthlessly killed the animals and either murdered natives or pressed them into service to hunt sea otters.

This appetite for otter fur had both good and evil consequences. On the one hand it caused the near extinction of the sea otter and terrible crimes against the native peoples, and on the other hand it spurred the exploration of the rich, north Pacific area. After the observant and intelligent Captain Cook had seen examples of sea otter skins at Nootka, on the west coast of Vancouver Island, he noted in his diary, " . . . and. therefore, the discovery of this part of the continent of North America, where so valuable an article of commerce may be met with, cannot be a matter of indifference."

Cook was followed by other British. The Spanish pushed exploration north, but finally dropped out of contention with the signing of the Treaty of Nootka. Last came the Americans. All wanted as much of the Alaska fur trade as possible. The vanishing sea otter continued to be relentlessly hunted with native crews and methods, but now with firearms and even nets.

The sea otter apparently was never very important to the natives. It was not a major source of food or fur. Furthermore, the native subsistence economy did not encourage over-exploitation of any resource. But when the white man appeared, with his cash economy and an insatiable market in China, Europe, and America, near extinction of the sea otter resulted, and irreparable damage to native peoples and their social institutions followed.

The natives responded in several ways. They first freely traded their furs to the whites, then they tried to fight them. The natives survived a period of slavery and finally were pulled into the economic system of the whites, where they could realize cash for sea otter skins or service as hunters. Without the markets for sea otter fur, exploration of the Pacific Northwest might have been considerably delayed, and the impact on native cultures very much less severe.

THE SEA OTTER IN CAPTIVITY

Murray L. Johnson

Why take a species from a wild and free environment and subject it to incarceration?—particularly an intelligent species with empathy for human beings.

Obviously this should not be tried unless certain criteria are met. First, the animal should be at home in his new captive environment, and should show evidence of health and inner peace. Second, is information needed that may be obtained by observation and scientific examination of the captive animals? Do we need, in our shrinking world, knowledge for placing the species back into its natural ecologic millieu so that it may survive in the future? Third, we need some guarantee that the individuals chosen for captivity will survive well.

We found in Tacoma that we could meet these criteria with the sea otter. It is a species of delicate constitution, just returning from the brink of extinction. We believed that, given proper conditions, it should be adaptable to a captive situation. Moreover, there is a definite need for refinements of captivity requirements so that the species may be transplanted safely for certain survival. Knowledge of many details of physiology and behavior to relate back to free-ranging populations has been fragmentary. And, being zoo-oriented, we knew that here was a species that should be introduced to people for education and enjoyment. The sea otter was a "natural."

Early experiences with sea otters

We were not the first to think about maintaining the species in captivity. In 1741 Georg Wilhelm Steller observed: "I have no doubt that if one were not begrudged the expense, a few of

these animals could be brought to Russia and made tame; indeed they would multiply perhaps in a pond or river, for they care but little for the sea water, and I have seen that they stay for several days in lakes and rivers . . ."

Steller was physician and naturalist for Bering on the voyage of exploration that discovered the sea otter.

Later came the near extinction of the species through greedy exploitation. The sea otter, the most valuable of all furbearers, was thought to be practically extirpated throughout its total range of the Pacific rim from northern Japan to southern California.

It is apparent that environmental conditions intervened to prevent total extinction. Small pockets of surviving sea otters persisted, protected by an environment hostile to man and their remoteness from human activity. Those in United States territory were in the waters of California south of Monterey and at the far end of the Aleutian Islands.

In the USSR, in this century, sea otters remained in only two areas—the southern tip of Kamchatka and the Commander Islands. A complete ban on hunting was imposed by the Soviets in 1924. At that time a maximum of 130 otters were counted around the Commander Islands, the largest group. By 1931 this number was estimated by Barabash-Nikiforov to be at least 500.

During these years several biologists published remarks about either the captivity or transplantation of sea otters. These two subjects are related, for, without knowledge of captive care, there is little hope of transplanting the animals over any distance.

Walter Eyerdam of Seattle in 1933 published a note that he had observed good numbers of sea otters in the Aleutians. Further, he suggested transplanting a couple of dozen pairs to the Pribilof Islands so that the otter might receive better protection against poachers.

In the meantime, several Russian biologists applied themselves to the problems of care and research on captive sea otters. In 1949 a book entitled *Kalan* (the sea otter) was published in Russia; it was translated into English for wider distribution, but not until 1962. This publication illuminated the need for holding sea otters in captivity and the problems of doing so. Barabash-Nikiforov in 1932 was unsuccessful in his first attempt to domesticate two sea otters in the Commander Islands. Mal'kovich had experience with eleven animals on Mednyi Island of the

Commander group during 1934 to 1936. These otters were kept in a waterfront enclosure that was destroyed in a storm, allowing the animals to escape.

Reshetkin and Shidlovskaya, in November 1937, brought two male sea otters, which they called Buyan and Yashka, from Mednyi Island to the Murmansk area of the Kola Peninsula. A litoral enclosure was provided. Yashka escaped in January 1940, and reportedly was seen in the area as late as the spring of 1942. What happened to Buyan was not mentioned. These authors give strict instructions for care of captive sea otters, including absolute cleanliness, feeding thrice daily, variation in diet which is preferably fresh (but can be frozen or salted if properly treated), and water for immersion at all times.

In September of 1955 a female ("Susie") was captured and brought to the Woodland Park Zoo in Seattle where, in a fresh-water pool, she established a longevity record of six years and one month for the species. Karl Kenyon (1971) presented a vivid description of Susie and her trials and tribulations. Much was learned from her, though she died with a terrible infestation of nasal mites (*Halarachne miroungae*), never found in the wild. This suggested that a salt-water environment might be the optimum captive situation.

During 1956 and 1957 Kenyon obtained considerable additional experience with keeping captive otters on Amchitka Island. All this was to be utilized in the future.

Further information was forthcoming when five more sea otters were obtained by a private collecting group for Woodland Park Zoo in Seattle in 1968. They were again kept in a fresh-water pool. Within a little over a year all but one had died, each of a different cause. One was found to be an old animal; another died of foreign body intestinal tract perforation; one was a nursing pup that could not survive after its mother died. Again, lessons were learned for the future.

And the future for Tacoma was five sea otters, 100% survival of fine healthy animals.

The Tacoma experience

In the early 1960's the Point Defiance Zoo pinpointed the sea otter as a priority item.

There was no logical reason why we should not be successful.

1. We had abundant good salt water. The tides rush into Puget Sound as a veritable river, through the 600-foot deep trough, by-passing the pollutant effects of Everett, Seattle, and Com-

mencement Bay. Our success with keeping many fragile invertebrate and vertebrate species in the Point Defiance Aquarium was a good biological test of purity.

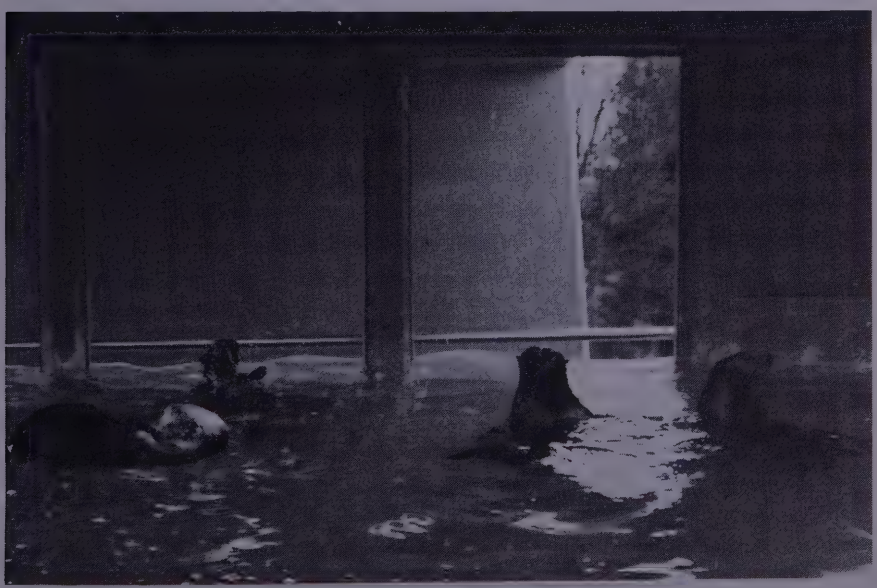
2. We had an expert director-keeper in Cecil Brosseau. His dedication and experience were evident in his success with other species.

3. We had within our Society expert marine biologists and others needed for back-up consultations in many fields.

4. We had a long and direct relationship with the staff of experts at the Marine Mammal Laboratory of the Fish and Wildlife Service in Seattle.

On the negative side was a problem of money, but who in our state of mind let this detail stand in the way? Our conservative Metropolitan Park Board must have been swayed the same way in their approval of the project.

So, on November 7, 1965, "Gus," our first sea otter, was captured by Government personnel. He made history by coming down on a slow boat (courtesy of the laboratory of radiation biology of the University of Washington), a voyage lasting many days. This was made possible by a deck pool with adequate flow of salt water. Gus arrived in splendid condition; the hard lessons learned trying to keep sea otters on dry grass or straw had paid off. Gus's method was, at least, one way of doing it, when air transportation was too expensive but a boat was available.



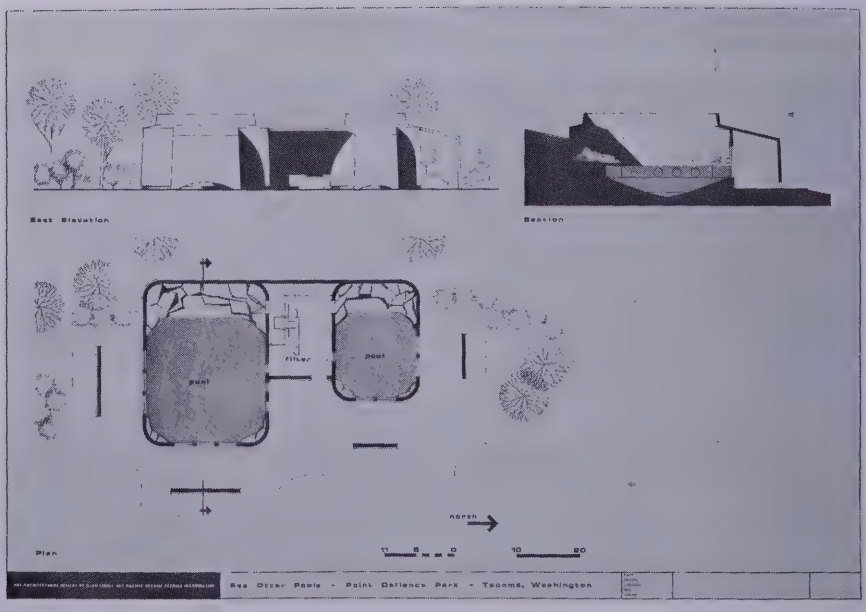
A view of the interior of the new sea otter enclosure at Point Defiance Park, Tacoma, Washington. Photo by Karl W. Kenyon

As the possibility of an otter approached, Cecil Brosseau had a "temporary" tight waterproof plywood pool built. It was 10 feet long, 5 feet wide, and 3 feet deep with a 26-gallon-a-minute flow of clean salt water. Viewing was through glass on one side, a fine wire mesh on the other, and a top wire mesh to prevent any foreign materials from entering. A wooden platform allowed for the otter's egress from the water.

We waited for plans to gel before getting more otters. From our temporary pool we learned that plenty of good water and food was more important than size.

Nearly four years (October 8, 1969) and about $35,000 later Gus and his four companions entered their planned double pool. "Ethel," a ten-year-old female, "Kalana" and "Chitka," two-year-old females, and "John," a two-year-old male, arrived July 31, 1969. They had been flown from Amchitka to Hoquiam, courtesy of the U.S. Atomic Energy Commission, then trucked to Tacoma. They came via the Division of Wildlife Research, Bureau of Sports Fisheries and Wildlife, the Marine Mammal Laboratory of Seattle, by special permit from the Alaska Department of Fish and Game. Karl Kenyon was on hand to help.

Our new facilities consisted of two pools, one larger than



The plan of the sea otter facility at Point Defiance Park, Tacoma, Washington, by the architectural offices of Alan Liddle.

A captive sea otter breaks clam shells on her chest by pounding one against the other with her paws. Photo by Karl W. Kenyon

the other, connected by a walkway between the two hauling-out areas, so that the sea otters could be herded one way or the other. The larger pool contained 5200 gallons of sea water and measured 20 feet in diameter and 4 feet 10 inches in depth. The other contained 2650 gallons, was 14 feet in diameter and of the same depth as the larger pool. Continuous circulation was provided by a combination of recirculation through a filter system at 110 gallons a minute and the addition of 10 gallons a minute of fresh sea water. In each pool a skimmer removed the floating debris, and the main drainage was at the dependent sloping bottom. The cement areas were covered with epoxy for smoothness. Viewing above and below water was provided the public on two of the three available sides. Today, this is the only major facility in the world planned and built specifically for sea otters.

Maintenance has centered around absolute cleanliness and plenty of food. The pools are emptied and cleaned daily and the filter system flushed. The staple food (filleted rock fish and small squid with vitamin supplement) is added daily. Food intake is large, up to 6.8 kg of food per animal per day. Kenyon (1969) calculated that Gus at 34.5 kg body weight required about 20%

of his body weight of fish and squid daily. The average cost of food per day is about $5 or $1800 a year.

The dispositions of the captive otters are good. They are intelligent, learn routines of management quickly, and recognize the people working with them. As long as no attempt is made to handle them, they remain friendly, though a nip is occasionally offered. Any physical handling, however, is a different matter. This they resist with vigor. Their loose fur coats make restraint doubly difficult. For any technical or instrumental examination anaesthesia is required, at least with our animals.

Interpersonal relationships within the colony were harmonious; the animals demanded company and fraternized well. Until sex entered in. Gus was the largest animal and the oldest male; Ethel was the only adult female in the original colony in 1969. Dominance fell to these older animals. After several weeks of a congenial group situation, a crisis arose, apparently when John, the young male, began making sexual advances toward Ethel. Gus then became viciously aggressive and separation was necessary. There was no improvement after several weeks of separation, so John was sent up to the Vancouver, B.C. Aquarium, unfortunately into solitary confinement. It is unlikely that serious conflict occurs between sea otters in the wild. The limited size of the captive situation must be blamed in this case.

The major disappointment has been failure to obtain reproduction within the colony so far. Breeding activity including courtship and copulation has been observed. Behavioral changes of the females have indicated the occurrence of estrus. Ethel went through a definite phase when physical appearance and behavioral activity indicated pregnancy; however, either absorption of the embryo or abortion must have occurred, for no pup was produced.

Otherwise the Tacoma colony must be declared a success. The animals are in the best of health as judged by activity, condition of the fur, awareness of their surroundings, and the thousand little observations that indicate a joy in living. Certainly they produce a feeling of joyousness in the thousands of visitors of all ages who stand entranced by their activities.

Research

If properly conceived, research activities with captive animals add important information for the benefit of the species (which may not be otherwise obtainable), and in no way detracts from the animals as fine exhibits. Such is the case with our sea otters.

Continuous observation by Cecil Brosseau, and by the scientific segment of the Tacoma Zoological Society, has given visiting scientists a wealth of factual data. The details of feeding requirements, reactions of the animals, and many other day-to-day activities have accumulated in recorded and non-recorded experiences. Such simple things as recording the amount of fur that is caught in the filters over the years gives data on molting that is not otherwise available.

In March of 1967, Roger Gentry and Richard S. Peterson (dec.) of the University of California at Santa Cruz spent most of a week in the original enclosure with Gus and later published an article on the underwater vision of the sea otter. Gus enjoyed this experience as much as did Gentry and Peterson. Extensive formal observation of behavioral activities of the sea otter were made by Arville Whitt of Pacific Lutheran University, working on a master's thesis. A total of 1981 man hours, totaling 5904 "man-otter hours" was spent April 1968 to February 1971 in Seattle and Tacoma on this project. Three times, a group of scientists has gathered during anaesthetization of individual sea otters—once with John and twice with Chitka. Blood specimens were obtained and multiple examinations made. These are as yet unreported, but are filed away as important data on healthy sea otters, for when problems arise in captive or wild populations.

During these past few years there have been transplants of sea otters from Alaska. These have been by air to Oregon, Washington, and British Columbia as cooperative federal-state (or provincial) arrangements. The first attempt was in 1969; at this time we received our four animals as part of a transplant group. A lesson, a contribution from the experiences with captive animals, was learned then: 100% of the Tacoma animals survived, without problems, but at least half of the transplanted animals perished. The important point was not to release animals immediately after prolonged air transport, without first allowing them to rest and feed in controlled situations. Subsequent attempts with temporary holding areas and food provided were successful.

There is much yet to be learned from this delightful species. May they continue to roam the free coastlines of the Pacific. But may some of them continue to lead happy lives in captivity and so allow many persons to see at close hand what we are preserving in the wild.

THE RETURN OF THE VANISHING SEA OTTER

Karl W. Kenyon

The sea otter, precious for its fur and unique characteristics, almost vanished during the last century because of overhunting. Thanks to careful management, this species has once again been reestablished along our Northwest coasts.

The only member of the order *Carnivora* among sea mammals, the sea otter, *Enhydra lutris,* is descended from a land mammal that went to sea; it is related to the river otter, weasel, and skunk of the family *Mustelidae.* Other members of this family may enter salt water, but the sea otter has never been recorded in freshwater rivers or lakes. It is also the smallest marine mammal, the adult male weighing up to 100 pounds and the female about 72 pounds. The maximum recorded length is 58 inches from tip of nose to tip of tail. Its tail is flattened and about one-quarter of the body length.

Although well adapted to shallow coasts, the sea otter does not share with the whales *(Cetacea)* and the seals *(Pinnipedia)* the specializations adapting it to live in other marine areas. It must obtain food from the bottom in relatively shallow water, and therefore cannot travel or migrate long distances at sea as do seals and whales. It differs from both seals and whales in not having an insulating layer of blubber, depending instead on its fur for insulation against the chilly marine environment. Therefore, the sea otter is particularly vulnerable to polluted waters. If oil or other foreign matter soils the fur and destroys the millions of tiny air pockets among the dry underfur fibers, water reaches the skin, and the otter soon dies of exposure. Since its body temperature is similar to man's, cold water directly on its skin

is as disastrous as the long-term exposure to Puget Sound water would be to the unprotected human swimmer.

The barrier between life and death is the sea otter's two-layered dry underfur. The sparse guard hair is about one and one-half inches long and the dense underfur about a quarter of an inch shorter. It grows in bundles, each bundle containing one guard hair and approximately 70 underfur roots. Studies by Victor B. Scheffer have shown that the sea otter's fur is nearly twice as dense as the fur seal's. Our calculations indicate that a large sea otter may have nearly a billion fur fibers.

Care of the fur is of primary importance. In order to maintain it in clean, waterproof condition, the sea otter grooms its fur many times a day. Visitors to zoos often assume that the sea otter has external parasites because they misinterpret grooming for scratching. But the sea otter is probably unique among mammals, for no external parasites (fleas or lice) have ever been found in its fur.

The forepaws are specialized for grooming and grasping food rather than for swimming. The front claws (but not the hind ones) are catlike—retractile, so that slippery food can be grasped; the extended claws may also aid in grooming.

Early hunters considered the fur of the sea otter of prime quality at all seasons. Recent studies have shown why; the molt of these animals is prolonged. No thinning or massive shedding of the fur is noticeable at any season, as is usual in other animals. The fur shed by our sea otter called "Gus," at the Tacoma Aquarium, was collected from the drain of his pool for a 24-hour period each week for a year by Cecil Brosseau, aquarium director. On examining the shed pelage samples, I found that, although the amount of fur shed in August was much more than in February, some shedding took place the year around. Thus, the sea otter is able to maintain its warm dense fur while at the same time changing its coat in a prolonged molt.

In general, the sea otter's coat may be dark brown or nearly black. Guard hairs may be light or dark. I have been told by Alaska game biologist John Vania, responsible for grading sea otter pelts for commercial sale, that, despite the general similarity in color, it is very difficult to match pelts to be sold in lots of three or four skins of nearly identical appearance. With age, the pelage of the head and chest may become quite grizzled and, in general, males tend to have lighter colored heads than females.

A captive adult female otter floating on her back and eating squid. This sho

The sea otter requires a large food intake—about 20% to 23% of its body weight in meat per day. Our large male, Gus, at Tacoma, weighs about 75 pounds and consistently eats 15 pounds of filleted fish and squid daily. With this large intake and the population limited to shallow water zones, a crowd of sea otters may seriously deplete food organisms. At Amchitka we found that fish, primarily sluggish bottom forms, were an important food item.

The teeth of sea otters are unique among carnivores. They do not have sharp cutting edges; even the canines are rounded. The

underarm pouch where she holds food temporarily before consuming it.
Photo by author

postcanines have flattened, rounded cusps well adapted to crushing the invertebrates, that are a primary food. Because the sea otter must scoop much of its food from the shells of clams, snails, and sea urchins, the lower incisors protrude forward so that soft parts may be scooped from shells. Unlike any other member of the order *Carnivora,* the sea otter has only two pairs of lower incisors; all other carnivores have three.

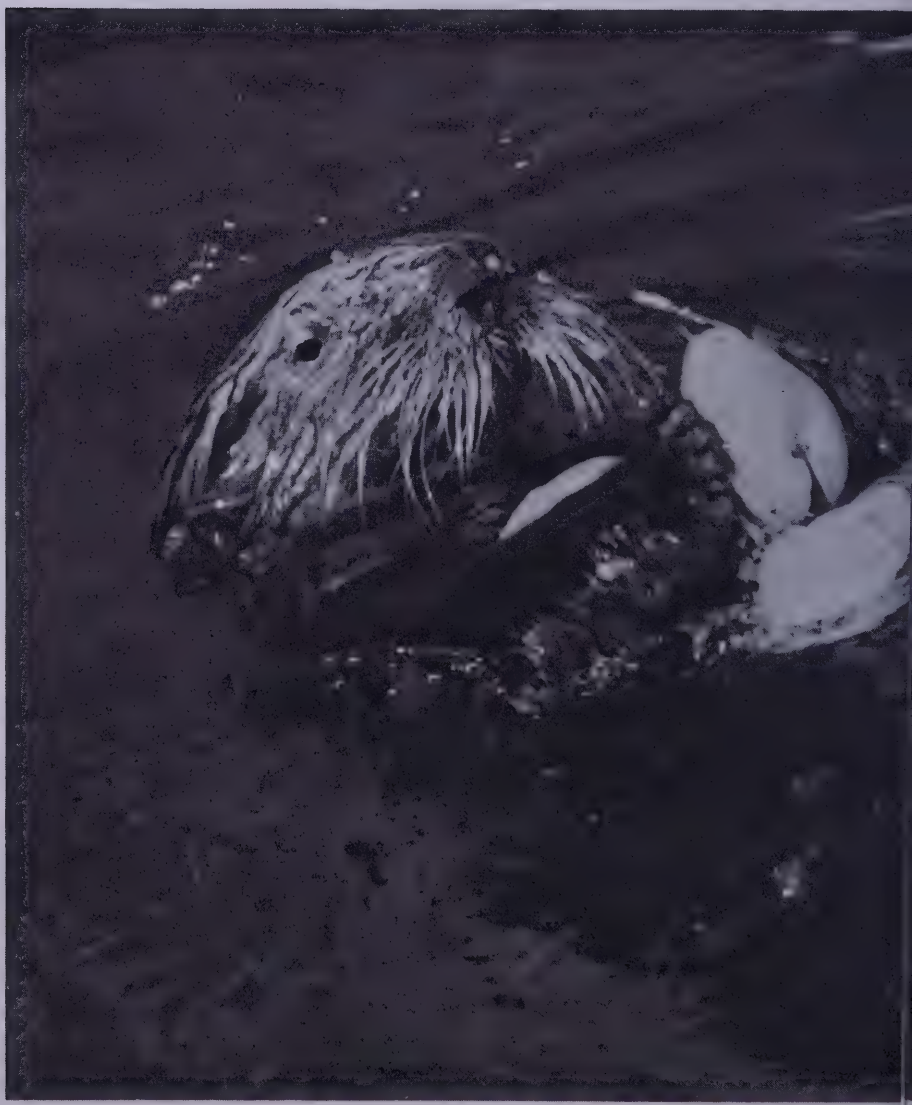
When the sea otter feeds, it dives to the bottom, collects food with its forepaws, and stores it under the left foreleg to carry it to the surface. This habit indicates that the sea otter is

right-handed. Under each foreleg and extending across the chest is a pouch of loose skin. In this pouch the otter may carry up to 25 sea urchins and a number of clams, depending on their size.

No exact information is available about the maximum depth to which a sea otter may dive. It was rare, however, on our aerial surveys to find one in water as deep as 180 feet. The majority were in waters 120 feet or less in depth.

The sea otter has the unique ability to use a stone as an anvil on which to break the shells of large clams and mussels. Susie, a female from Amchitka that lived at the Woodland Park Zoo,

An otter, floating on its back, pounds one clam agains



used stones to break the concrete edge of her pool, so the stones had to be removed. She also used a stone to hammer the cover of her drain so that she could reach into the mysterious dark hole beneath. Although we did not notice sea otters using stones as anvils or hammers in Alaska, animals caught in Alaska used stones as soon as they were given them in captivity. This habit is often observed among sea otters on the California coast. The only explanation for wild otters not using the stone in Alaska is that usually the organisms which they feed on are small enough to be crushed by their teeth.

ther on its chest, to crack the shell. Photo by author

Much has been written of the mother sea otter's solicitude for her young. To insure survival in its harsh environment a mother must give her pup almost constant attention from the day it is born until it is a year old or more. Although there are records that more than one fetus has been found in the reproductive tract of a female sea otter, we have never seen more than one young with a mother. Because the mother must carry the pup on her chest while she swims on her back and meticulously grooms its fur at frequent intervals, it would probably be impossible for a mother to raise more than one pup at a time.

The mother sea otter is somewhat solitary, although several mothers and young may feed in one area and bring their young ashore on the same rocks. Mothers with young are not nearly as gregarious as certain groups of males which may come ashore and sleep close together on some habitually used beach.

Pups may be born during all months of the year. Our field counts of young and studies of reproductive tracts, however, indicate that the majority of young are born in the late spring and summer months. Studies of reproductive tracts also show that there is a period of delayed implantation during which the fertilized ovum rests The exact lengths of the unimplanted period and the period of fetal development are not known, but the total gestation period including both may be more than a year.

The mating period may last approximately three days, at which time the mated pair center their activities around a chosen rock. Mating takes place in the water near the rock and the animals feed close together nearby. During food dives, the male follows the female closely and emerges an instant after she does to eat beside her as they float on their backs at the surface. At night they haul out together and sleep alongside each other on the chosen rock.

The female terminates the mating period. On several occasions I watched the breaking of the pair bond. Apparently the male otter, requiring more food than the smaller female, left her on the chosen rock while he gathered food and ate nearby. As his feeding activity carried him perhaps 200 feet from the chosen rock, the female watched him intently. Suddenly she left the rock and swam rapidly away under water while the male was diving for food. After the male noted her absence, he hurriedly explored the chosen rock and other rocks in the vicinity. Never did I see a male find his mate once she had deserted him.

When the sea otter pup is born it has a long, warm coat of

dense woolly fur. At birth it is brownish with a pale yellow tinge. Within several weeks, the yellowish guard hairs grow to nearly two inches, giving the pup a distinct yellowish look.

The pup's eyes are open at birth; it weighs about five pounds, and is helpless. While the mother dives for food, the pup sleeps warmly on the water, buoyed up by the blanket of air in its fur. If it awakes during the mother's absence beneath the surface, the pup may squirm about and make swimming motions but it cannot swim. When the pup first tries to dive at several months old its buoyant fur keeps it from submerging. It needs many weeks of practice before it learns to reach bottom, and when it does it usually brings up worthless items such as pebbles and small sea urchins of little or no food value. As it approaches a year old, it may obtain some of its own food, but it is primarily dependent on sharing its mother's food. Early in life the pup receives most of its nourishment from its mother's two abdominal nipples, but shortly after birth it receives small solid items of food from its mother's paws.

Because of the long periods of both gestation and dependency, intervals between births are probably at least two years. Despite this low reproductive rate, the excellent maternal care probably assures a high rate of survival.

The sea otter has relatively few predators. A Soviet biologist has recorded an observation of a killer whale attacking sea otters. I have seen killer whales and sea otters in the same areas but saw no indication that the killer whales disturbed the sea otters. It has been supposed that bald eagles frequently took baby sea otters while the mother was beneath the surface gathering food. There is only one observation, however, of such a thing occurring, and I have frequently seen baby sea otters and eagles in the same areas. In California the tooth of a great white or maneater shark was removed from the lacerated body of a dead sea otter. In general, however, except for man, predation on the sea otter is unimportant.

But the protection of sea otters and their increased numbers have brought about some reversal of the situation. In some situations, the sea otter may be viewed as the predator. In California, at present, a heated controversy rages between "The Friends of the Sea Otter" and "The Friends of the Abalone." The cause of this controversy is that a growing sea otter population is entering areas used by commercial abalone fishermen.

Sea otters not only use a stone to break mollusks on their

chests; they also are capable of pounding the shell of an abalone with a stone until it breaks, after which they may remove the abalone from the bottom and carry it to the surface where they eat it. Most biologists who have studied the sea otter believe that, if a healthy sea otter population and a healthy abalone population are to be maintained in the same area, studies and management program will be necessary for these species. Otherwise, eventually, a large sea otter population will join with the abalone fishermen to deplete the abalone resource. Then the otters will move to other areas or starve, and the abalone fishermen will have to seek other occupations.

At the time of its discovery in 1741, the sea otter ranged from central Baja California, north along the coast and among the islands of North America to a northernmost limit in Prince William Sound, Alaska. From here it ranged southwestward along the Alaska Peninsula through the Aleutian, Commander, and Kuril Islands to northern Japan. Populations in the Pribilof Islands were exterminated soon after these islands were discovered in 1786. During the century and a half of wholesale exploitation, the sea otter vanished from much of its original range. Because of the great value of the fur, men spent years seeking out the last surviving sea otters in isolated areas.

By 1911, when the sea otter was given protection, it was thought by many scientists that the population had been so drastically reduced that the survival of the species was doubtful. Little was seen or heard of the sea otter between 1911 and the mid-1930's. During this period, scattered reports to the Bureau of Fisheries were received and a few skins were confiscated. These records indicated that several tiny seed populations of sea otters in the outer Aleutian Islands and along the Alaska peninsula remained. Undoubtedly the harsh environment and many outlying reefs protected these animals from hunters.

By the mid-1940's several growing sea otter populations were surveyed. One at Amchitka Island was particularly prosperous and numbered some thousands of animals during the mid-1940's. Besides the Alaska population, a remnant population on the California coast survived, as did a small group in the Commander and Kuril Islands.

As early as the mid-1940's, certain Aleutian Island populations began to overcrowd their habitat, exceeding the maximum numbers that food resources could support. Field observers reported numbers of animals dying on beaches. At first it was

supposed that these "die-offs" were the result of a disease, and biologists began systematic studies of the sea otter. These were centered at Amchitka Island, Alaska.

During the course of several seasons work, I found that most of the otters that died on beaches were either large juveniles or older animals having seriously worn teeth. Healthy young adults seldom appeared among the beach dead. Studies in other less crowded areas indicated that winter mortality was slight. Examination of the animals that died in the crowded Amchitka population showed that they were emaciated and had no body fat.

The stomachs and intestines of the animals dying on Amchitka beaches contained only the remains of small sea urchins. Analysis of the food value of organisms available to sea otters at Amchitka showed that certain of the invertebrates were valueless as food; the otters were dying of starvation. Strong animals in their prime were able to catch fish, and more than 50% of the food found in such animals that we collected contained fish. The animals dying on beaches were the young, newly separated from mothers, and those with worn-out teeth, weakened by age, and unable to capture more nutritious but elusive prey.

Aerial surveys conducted between 1959 and 1965 covered most of the sea otters' former habitat in Alaska, a distance of some 2000 linear miles. We counted nearly 18,000 otters and calculated that at that time there were about 30,000. Our studies showed also that certain otter populations were increasing at a rate of about five percent per year. From this, and with population data from the Soviet Union, we estimate that the world population today may be between 40,000 and 50,000 animals.

In 1969 and 1970, the California Department of Fish and Game surveyed their otter population. They found that it had grown from about 100 animals in the mid-1930's to well over 1000, occupying over 100 miles of coastline between Monterey and Point Conception.

Continuing surveys of the Alaska population by Alaska game biologist Karl Schneider indicate that many populations are still growing. In early 1970, the largest assemblage of otters ever photographed contained over 1000 animals. This group was in the Bering Sea north of the Alaska Peninsula. There are no kelp beds in this area, but the animals gather there to feed on the rich bottom fauna of the shallow Bering Sea.

There are myths about sea otters: one is that they need kelp beds in their habitat. Although sea otters appear to prefer kelp

An aerial view showing a raft of otter resting in a kelp bed near Adak Island, Alaska. Photo by author

beds and use the kelp draped across their body while sleeping to prevent drifting, they do not require kelp beds. In certain Bering Sea areas, large numbers of sea otters thrive the year around where there are no kelp beds at all. They appear to sleep quite comfortably on the open sea. A second myth is that sea urchins form an essential item of their diet. Although adult sea urchins with large egg masses are highly nutritious and furnish excellent sea otter food, small sea urchins and those with undeveloped egg masses are almost useless as food. Thus, animals died of starvation while consuming quantities of small urchins at Amchitka. When emaciated, starved sea otters were fed fish in our enclosure; they quickly regained health and refused to eat the sea urchins.

A third myth is that kelp is a sea otter food. Although sea otters may eat kelp from time to time, partly because it is stuck to other food items, it passes through the entire gastro-intestinal tract and shows no signs of digestion. Sea otters are also apparently unable to digest the meat of birds and seals, some of which we attempted experimentally to feed them in captivity. Another myth is that sea otters will "play catch" with a wad or ball of kelp.

We often receive reports from residents or visitors in Washington's San Juan Islands that they have seen sea otters. After investigating many of these, we found that in every case the reports concerned river otters, which are abundant in salt water among the San Juans and other islands north to Alaska. The differences between the two species are easily observed. The sea

otter always eats while floating high on its back in the water. It never goes out onto the rocks to eat as the river otter frequently does. Also, the river otter has a relatively long tail (about one-half its body length), heavily thickened at its base, while the sea otter has a relatively short (about one-third its body length), flattened tail. It seems unlikely that sea otters ever frequented the area of the San Juan Islands. In early times, explorers recorded that they could not get sea otter skins from natives of the inland waters but had to get them from Nootka Sound and other areas on the outer coast.

Many years elapsed between the successful transplant of sea otters to the outer coasts of Washington and Oregon in 1970, and our first clumsy efforts to transport them from Alaska in 1955. At that time the trip from Amchitka to Seattle took from 24 to 72 hours. In July of 1970, the transplant shipment came direct from Amchitka to Washington in about seven and one-half hours. Fortunately, also in 1970, the Washington Department of Game was well prepared. A holding pool was ready at LaPush when the four-engine Hercules aircraft landed with 30 adult otters on July 17. As the animals groomed and fed in their floating enclosure, we could see that they were in excellent condition. When these animals were liberated on July 22 they were quite contented. No indication has been found that any died.

These successful transplants are the result of cooperation between the Alaska Department of Fish and Game, the Bureau of Sport Fisheries and Wildlife and the Washington Department of Game.

Today we view a sea otter population that has recovered from near extinction in 1911 to overabundance in some areas and developing, healthy populations in others. Crowded island populations in the north are being cropped under the watchful eyes of Alaska's wildlife biologists. It is too early yet to know whether or not the new seed populations on the coasts of Oregon, Washington, and Southeastern Alaska, established during the past five years, will produce viable colonies.

The evolution of man's attention to the sea otter is now completed. It began with wasteful exploitation (1741-1911), proceeded to absolute protection (1911-1962), and finally culminated in a well-balanced management program that began in 1962. The species once thought to be doomed is now safely reestablished, and there is no question of the ability of the populations to safely yield an annual harvest of furs.

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Karl Kenyon prepared this list based on the following needs: (1) availability of the publication to the general public; (2) an effort to include a broad geographic coverage; (3) to include historical works; and (4) to present the present status and biological knowledge of the sea otter.

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